REMARKS

Favorable reconsideration of this application is requested in view of the above amendments and the following remarks. The title, claims 1, 9, and 10 are hereby amended. Claims 14 and 15 are new. Claims 2-8 are cancelled without prejudice.

The claim 1 amendments reciting "a plurality of horizontal charge transfer paths" and "a plurality of read-out amplifiers for receiving signals from the respective horizontal charge transfer path", are supported on page 6, lines 2-6. The claim 1 amendment reciting "the pitch B reducing gradually from the photoelectric conversion region... so that the vertical charge transfer paths are squeezed together", is supported by figure 4 and page 5, lines 20-27. The claim 1 amendment reciting "the read-out amplifier and the horizontal charge transfer path... so as to be provided at a horizontal spacing that is not larger than the width of the section", is supported by figure 1. The claim 1 amendment reciting "each of the read-out amplifiers is placed... so as to be placed directly adjacent to the last stage of the horizontal transfer path", is supported on page 6, lines 6-9. The claim 1 amendment reciting "a plurality of transfer electrodes... charge transfer paths", is supported by original claim 8 and page 5, lines 5-9.

Claims 9 and 10 are rewritten in independent form. The claim 9 amendment reciting "the vertical charge transfer paths", is supported on page 5, lines 5-6.

New claims 14 and 15 correspond to matter from claim 13.

The claims were objected for being single spaced. A substitute set of the original claims is enclosed.

Claims 6 and 7 were objected as being of improper dependent form. Claims 6 and 7 are cancelled, rendering this issue moot.

Claim 1 was rejected as being anticipated by Toyama (JP 06045576). Applicants traverse this rejection. Toyama, figure 1, teaches away from the claim 1 feature of "the read-out amplifier and the horizontal charge transfer path... to be provided at a horizontal spacing that is not larger than the width of the section". Figure 1 clearly shows the amplifier and charge transfer path are longer than the width of it's respective photoelectric conversion region partition. Further Shigera does not teach the read-out amplifiers to be "placed directly adjacent to the last stage of the horizontal transfer path". Even further, Toyama does not suggest that "pulses can be applied to the transfer electrodes independently from other portions of the vertical charge transfer paths". Favorable reconsideration of claim 1 is requested.

Claims 1-6, 12, and 13 are rejected as being anticipated by Kiik (EP 0 866 502 A2). Applicants traverse this rejection. See the previous remarks regarding Toyama, as Kiik fails to teach the same features. Claims 2-6 are cancelled. Applicants are not conceding the correctness of the rejection. Claims 12 and 13 depend from claim 1 and are allowable over Kiik for at least the same reasons. Favorable reconsideration of claims 1, 12, and 13 is requested.

Claim 7 was rejected as being anticipated by Furumiya (US-5,742,081). Claim 7 is cancelled. Applicants are not conceding the correctness of the rejection.

Claims 8, 9, and 11 were rejected as being unpatentable over Kiik in view of Morcom (US-4,835,616). Applicants traverse this rejection. Claim 8 is cancelled. Applicants are not conceding the correctness of the rejection.

Regarding claim 9, Morcom does not correct the deficiencies of Kiik. Morcom does not suggest the effect of locating the bent portion between the adjacent transfer electrodes. While Morcom does teach the "transfer electrodes being positioned above vertical transfer paths, with the break between the imaging and storage sections occurring below locations between the transfer electrodes", the break between the imaging and storage sections is not relevant to the bent portion of the vertical charge transfer path. The bent portion is never positioned at that

location. Claim 9 recites that the bent portion of the vertical charge transfer path is positioned precisely below locations between the adjacent transfer electrodes (see figure 8A). This structure allows transfer losses to be suppressed. In contrast, when the bent portion is arranged below the center of the transfer electrode 72 (figure 8B), transfer losses tend to occur below this transfer electrode. When a transfer pulse is applied to the transfer electrode 72 (figure 8B), the bent portion causes a groove in the electric potential that is positioned in the middle of the transfer electrode. This effect is shown in the enclosed reference figure B. The groove in the electric potential impedes the charge transfer. If the bent portion is positioned below the precise location between the adjacent transfer electrodes, as in figure 8A, the groove in the electric potential does not occur (see enclosed reference figure A). Favorable reconsideration of claim 9 is requested.

Regarding claim 11, which depends from claim 1, Morcom does not correct the deficiencies of Kiik. Claim 1 recites that "transfer driving pulses can be applied to the transfer electrodes independently from other portions of the vertical charge transfer paths". Morcom does not show that transfer driving pulses can be applied to independent transfer electrodes. In contrast, Morcom shows common wiring for electrodes carrying pulses $I\Phi_1$, $I\Phi_2$, $I\Phi_3$, $S\Phi_1$, $S\Phi_2$, and $S\Phi_3$. For example, the pulse $I\Phi_1$ is applied to four different electrodes and cannot be applied to any transfer electrode independently. As claimed, independent transfer driving pulses allows suppression of transfer losses in the bent portions of the vertical charge transfer paths. In contrast, Morcom's transfer driving pulse is rounded until it reaches the transfer electrode in the middle of the imaging device chip. Morcom teaches that the bent portion of the transfer path is located in the middle of the chip. The bent portion causes transfer losses due to strain and the effects of the pulse rounding. Favorable reconsideration of claim 11 is requested.

Claim 7 was rejected as being unpatentable over Kiik in view of Furumiya. Claim 7 is cancelled. Applicants are not conceding the correctness of the rejection.

In view of the above, favorable reconsideration in the form of a notice of allowance is requested. Any questions regarding this communication can be directed to the undersigned attorney, Douglas P. Mueller, Reg. No. 30,300, at (612)371-5237.

Respectfully submitted,

MERCHANT & GOULD P.C.
P.O. Box 2903
Minneapolis, Minnesota 55402-0903
(612) 332-5300

23552
PATENT TRADEMARK OFFICE

Dated: November 23, 2004

By _____
Douglas P. Mueller
Reg. No. 30,300

DPM:mfe

WHAT IS CLAIMED IS:

1. A solid–state imaging device, comprising:

a photoelectric conversion region including:

a plurality of photoelectric conversion portions arranged in rows and columns extending in a vertical direction and a horizontal direction; and

a plurality of vertical charge transfer paths extending substantially in parallel to the columns of the photoelectric conversion portions; and

a horizontal charge transfer path for receiving signals from the plurality of vertical charge transfer paths;

wherein the plurality of vertical charge transfer paths is arranged at a horizontal pitch A within the photoelectric conversion region, and at a pitch B that is smaller than the pitch A in a portion where the signals are input into the horizontal charge transfer path.

2. The solid–state imaging device of Claim 1, further comprising a read–out amplifier for receiving signals from the horizontal charge transfer path, wherein the read–out amplifier and the horizontal charge transfer path for receiving signals from the plurality of vertical charge transfer paths are provided for each section into which the photoelectric conversion region is partitioned along the vertical direction.

3. The solid–state imaging device of Claim 2, wherein the read–out amplifier and the horizontal charge transfer path for receiving signals from the plurality of vertical charge transfer paths are provided at a horizontal spacing that is not larger than the width of the section into which the photoelectric conversion region is partitioned.

4. The solid–state imaging device of Claim 2, wherein a plurality of solid–state imaging blocks of substantially the same shape are arranged next to one another in the horizontal direction, each solid–state imaging block comprising:

one of the sections into which the photoelectric conversion region has been partitioned;

one horizontal transfer path for receiving signals from this section; and

one read–out amplifier for receiving signals from this horizontal transfer path.

5. The solid–state imaging device of Claim 2, wherein the vertical charge transfer paths are arranged at the horizontal pitch A also where the sections into which the photoelectric conversion region has been partitioned border onto one another.

6. The solid–state imaging device of Claim 1, wherein a horizontal width of the vertical charge transfer paths is substantially constant from a portion at the photoelectric conversion region to a portion at the horizontal charge transfer portion.

7. The solid–state imaging device of Claim 1, wherein a horizontal width of the vertical charge transfer paths increases gradually or step–wise from a portion at the photoelectric conversion region to a portion at the horizontal charge transfer portion.

8. The solid–state imaging device of Claim 1, wherein a plurality of transfer electrodes are arranged above the vertical charge transfer paths and are wired such that, at least in bent portions of the vertical charge transfer paths, transfer driving pulses can be applied independently from other portions of the vertical charge transfer paths.

9. The solid–state imaging device of Claim 1, wherein a plurality of transfer electrodes are arranged such that bent portions of the vertical charge transfer paths are positioned below locations between the transfer electrodes.

10. The solid–state imaging device of Claim 1, wherein

bent portions of the vertical charge transfer paths are positioned below predetermined transfer electrodes; and

a transfer path length on which a transfer driving pulse is applied with said predetermined transfer electrodes is shorter than a transfer path length on which the transfer driving pulse is applied with transfer electrodes that are adjacent to said predetermined transfer electrodes.

11. The solid–state imaging device of Claim 1, wherein a conducting line that is electrically connected to a plurality of transfer electrodes with which the transfer driving pulse is applied to the vertical charge transfer paths is provided substantially in parallel to the vertical charge transfer paths at least from a photoelectric conversion region to a region in which the vertical charge transfer paths are arranged with less than the horizontal pitch A.

12. The solid–state imaging device of Claim 1, wherein the largest bending angle in the vertical charge transfer paths is not more than 45°.

13. An imaging system, comprising:

the solid–state imaging device of Claim 2; and

a signal processing portion that synthesizes output from the read–out amplifiers of the sections of the solid–state imaging device, and corrects the image at joint portions corresponding to portions where the sections border with one another, so as to display one image.